SUBJECT: Toxicity Data for Polynuclear Aromatic Hydrocarbons: Reilly Tar Site in St. Louis Park, Minnesota

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Your April 18, 1984, memorandum requests carcinogenic and general toxicity data for Polynuclear Aromatic Hydrocarbons (PAH). On short notice the only cancer assessment data base that we can refer to is assessment data that was prepared for water quality criteria purposes in both 1980 and 1982. As for the availability of noncarcinogenicity toxicity for PAH's, there is one other compound for which noncarcinogenic health data exists and hence, a related criterion value.

CARCINOGENICITY

Out of the 13 PAH compounds on the list of 129 water quality priority pollutants, there are six PAH compounds which have qualitative evidence of being carcinogenic in experimental animals. One of these, benzo-a-pyrene (BaP), has adequate animal data for oral cancer potency estimation.

Chemical

1. Benzo-(a)-pyrene
2. Benzo-(b)-fluoranthene
3. Benzo-(a)-anthracene
4. Indeno-(1,2,3,-c,d)-pyrene
5. Dibenzo-(a,h)-anthrene
6. Chrysene

Our scan of new literature suggests that other PAH compounds have evidence

of carcinogenicity. We can t, however, in this short time fr , offer an evaluation of this new data, except to say that the total number of compounds with carcinogenic evidence may increase to 12 or more.

Since there are no studies available regarding chronic oral exposure to PAH mixtures, it is necessary to derive carcinogenic potency factors and/or criteria levels using data on individual compounds, and thereafter, devise a method for using these potencies in a mixture situation. We have at the moment a potency factor estimate and a water quality criterion level based upon the potency of benzo-(a)-pyrene, (BaP). As referenced in the EPA Report 440/5-80-069 Ambient Water Quality Criteria for Polynuclear Aromatic Hydrocarbons dated October 1980, the carcinogenic potency factor of BaP for humans, based on an animal oral ingestion study, is:

$$q_1^* = 11.53 \text{ (mg/kg/day)}^{-1}.$$

Using this potency factor and the exposure assumption of ingesting 2 liters of water containing BaP, the concentrations of BaP contaminant and the corresponding to upper-limit risk levels of 10^{-5} to 10^{-7} is shown below. These vary slightly from the water quality criterion because the ingestion of contaminated fish is not included in this exposure consideration.

BaP Concentration in Water, C*	Corresponding Lifetime Risk Level for 70 kg Person Assuming a 70 Year Lifetime Exposure
30 ng/l [30×10^{-6} mg/l]	10^{-5}
3.0 ng/l	10^{-6}
0.3 ng/l	10^{-7}

$$^*C \text{ (mg/l)} = 70 \frac{\text{(assumed risk level)}}{2\ (q_1)}$$

Interpretation and Use of Risk Data

Recognizing that BaP is only one of the PAHs and that direct cancer potency estimation was not feasible in 1980 and 1982 for other PAH compounds, the 1982 Ambient Water Quality Criteria Document Errata for PAH proposed that an assumption be used for PAH mixtures. The assumption was that each PAH compound showing evidence of carcinogenicity be assumed to be as potent as BaP and that, therefore, the carcinogenic effect of a mixture would be proportional to the sum of individual compound concentrations. Using this rationale, the sum of concentrations of all compounds with identifiable carcinogenic evidence is assumed to be equivalent to a like concentration of BaP, and hence, the upper-limit risk of the mixture is assumed to be equal to or less than the risk estimated for BaP.

At this writing, without time to re-evaluate the data base, our recommendation is to utilize the rationale above which is quite similar to that used in developing the 1980 water quality criteria, the differences being a slightly longer list of compounds with carcinogenic evidence which would lengthen the list of compounds for which concentrations are additive, and not using the ingestion of contaminated fish as a factor in human exposure.

Unlike a case where we are concerned about the carcinogenic effect of a single compound, the presence of multiple compounds raises the possibility of co-carcinogenic and related synergistic and/or antagonistic effects. Additionally, there is the fact that many of the PAHs show evidence of mutagenic potential. Since scientifically we are not ready to recommend the best method of quantifying these other hazards from a risk assessment standpoint, the additivity rationale is the only assessment alternative.

The magnitude for overestimation or underestimation of cancer risk using the additive approach is uncertain given the unknowns about PAH mixtures and the risk estimation techniques. On the one hand our lack of knowledge about the mixture's effects on cancer potency, that is our lack of knowledge but suspicion about cocarcinogenicity and other attenuating properties of a mixture and likewise the mutagenic potential of many of the PAH compounds, gives reason not to knowingly underestimate the possible hazards of ingesting PAH mixtures. On the other hand, our preliminary analysis indicates that BaP is one of the more potent of the six compounds, therefore, affording a possibility of over compensation when the additive rationale is used for a broad spectrum mixture. The larger the amount of BaP and/or dibenzo (a,h) anthracene in the mixture the less the possibility for over compensation. Further, it should be recognized that the risk estimation techniques used with the BaP data produce an upper-limit estimate of risk so that the true risks are likely not to exceed this upper limit value.

It must be noted that an epidemiology study of people living near the Reilly Tar Site would provide a more realistic estimate of the risk from this mixture, if the population exposure could be well documented. Such a proposal has been made by the Office of Health and Environmental Assessment (OHEA) and waits approval. Also, to repeat, we do have indications that newer animal data is available regarding the carcinogenicity of PAH compounds, however, time does not permit an examination of these data.

Non Carcinogenic - General Toxicity

In 1980, water quality criteria for fluoranthene and acenaphthene were recommended. The fluoranthene criterion was based upon health considerations while the acenaphthene level was based upon organoleptic considerations (taste and odor).

The fluoranthene criterion concentration, based upon ingesting 2 liters of water per day containing fluoranthene, with an uncertainity factor of 1000, is 0.2 mg/l. This value would be presumed protective of human health until new data is available which would enhance the assessment of the compound's toxicity. The 0.2 mg/l value differs from the 1980 water quality criterion level of 42.0

ug/l because the exposure assumption regarding the ingestion of contaminated fish is not appropriate and hence not used.

The acenaphthene criterion level 0.02 mg/l has no basis in health since sufficient data was not available to adequately evaluate toxicity. The use of this value should be carefully considered since no association with health benefits can be made.

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